AEG
POWER SOLUTIONS

Protect PV - Solar Inverters
Installation Manual

AEG Power Solutions GmbH

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1. Safety and Conformity

1.1. Safety Information

All persons installing and servicing inverters must be:

- Trained and experienced in general safety rules for work on electrical equipment
- Familiar with local requirements, rules and regulations for the installation

Safety information important for human safety. Violation of warnings may result in injury to persons or death.

Information important for the protection of property. Violation of this type of information may cause damage and loss of property.

Note: ✍
Useful additional information or "Tips and Tricks" on specific subjects.

Read this before installing, operating or maintaining the inverter.

Before installation:
Check for damage to inverter and packaging. If in doubt, contact the supplier before installing the inverter.
Installation:
For optimum safety, follow the steps described in this manual. Keep in mind that the inverter has two voltage carrying sides; the PV input and the AC grid.
Disconnecting the inverter:
Before starting work on the inverter, switch off AC grid at the mains switch and PV using the PV load switch. Ensure that the device cannot be unintentionally reconnected. Use a voltage tester to ensure that the unit is disconnected and voltage free. The inverter can still be charged with very high voltage at hazardous levels even when it is disconnected from grid/mains and solar modules. Wait at least 30 min. following disconnection from grid and PV panels before proceeding.
Maintenance and modification:
Only authorised personnel are allowed to repair or modify the inverter. To ensure optimum personal safety, only original spare parts available from the supplier should be used. If non-original spare parts are used, the compliance with CE guidelines in respect of electrical safety, EMC and machine safety is not guaranteed.
Also observe the danger of burn injury. The temperature of the cooling racks and components inside the inverter may exceed 70ºC.
Functional safety parameters:
Never change the parameters of the inverter without authorisation from the local energy supply company and instructions from AEG PS.
Unauthorised changes of functional safety parameters may cause injury or accidents to people or inverter. Additionally it will lead to the cancellation of all inverter operating approval certificates.
The AEG PS inverters are all designed according to the German VDE0126-1-1 (February 2006) standard, which includes an insulation test between PV array(s) and Earth, and a type B, RCMU according to DIN VDE 0100-712.

1.2. Hazards of PV Systems

Very high DC voltages are present in the system even when the AC grid is disconnected. Faults or inappropriate use may lead to electric arcing. Do not work on the inverter while it has current connected to it.
The short-circuit current of the photovoltaic panels is only slightly higher than the maximum operating current and depends on the level of solar irradiation.

1.3. PV Load Switch

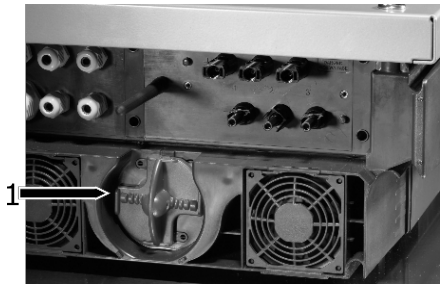

Illustration 1.1: Protect PV PV Load Switch

The inverter has been equipped with a PV load switch (1) for safe disconnection of DC current.

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1.4. Conformity

1.4.1. Approvals and Certifications

For more information, go to the download area at www.aegps.com/solarinverters, Approvals and Certifications.

CE	CE marking - This certifies the conformity of the equipment with the regulations which apply in accordance with the directives 2004/108/EC and 2006/95/EC.

2. Introduction

2.1. Introduction

This manual explains the installation and setup of the Protect PV solar inverter, for the installation technician.

Illustration 2.1: Protect PV 10 kW, Protect PV 12.5 kW, Protect PV 15 kW

CE	CE marking - This certifies the conformity of the equipment with the regulations which apply in accordance with the directives 2004/108/EC and 2006/95/EC.

The Protect PV inverter series comprises:
Protect PV
Protect PV easy

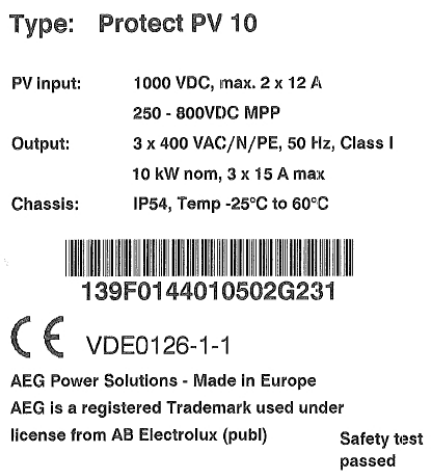
Common features of the Protect PV variants:

- Output rating of 10 kW, 12.5 kW or 15 kW
- IP 54 enclosure
- PV load switch
- MC4 connectors

Protect PV variant	User interface		Ancillary services			DC power rating
	Local	Web Server	Power Level Adjustment, Primary Frequency Control	Ride Through	Fault Ride Through Reactive Power	10 kW 12.5 kW 15 kW
Protect PV	✓		✓	✓	✓	✓
Protect PV easy	✓	✓	✓	✓	✓	✓

Table 2.1: Differing Features of Protect PV Variants

Product Label


Type: Protect PV 10
PV input: 1000 VDC, max. 2 x 12 A
250 - 800VDC MPP
Output: 3 x 400 VAC/N/PE, 50 Hz, Class I
10 kW nom, 3 x 15 A max
Chassis: IP54, Temp -25°C to 60°C
139F0144010502G231
VDE0126-1-1
AEG Power Solutions - Made in Europe
AEG is a registered Trademark used under
license from AB Electrolux (publ)
Safety test passed

The product label on the side of the inverter shows:

- Inverter type
- Important specifications
- Serial number, see (1), for identification by AEG PS

Illustration 2.2: Product Label

2.1.1. Installation Sequence

1. Read the installation manual. Pay special attention to the section *Important Safety Information*.
2. Install the inverter according to the section *Installation Dimensions and Patterns* and the section *Mounting the Inverter*.
3. Open the inverter according to the section *Opening and Closing the Inverter*.
4. Install AC according to the section *AC Grid Connection*.
5. Install PV. Remember to use the terminal block to establish parallel connection (if required), as described in the section *PV Connection*. The inverter has auto-detection.
6. Install Auxiliary input according to the section *Connection of Peripheral Units*.
7. Close the inverter according to the section *Opening and Closing the Inverter*.
8. Turn on AC at the mains switch.
9. Set language, time, date, installed PV power and country:
   - For setup via the integrated Web Server, see the Protect PV User Manual,Web Server Quick Guide section
   - For setup via the display, see the section *Start-up and Check of Settings* in this manual.
10. Turn on PV by turning the PV load switch on.
11. Verify the installation by comparing with the auto-detection result in the display, as described in the section *PV Connection*.
12. The inverter is now ready for operation.

2.1.2. Overview of Inverter

Illustration 2.3: Overview of AEG PS Protect PV inverter

Live Part

1. AC Connection Area
2. DC Connection Area
3. Terminal block for parallel connection
4. Auxiliary output: Potential free relay

PELV (Safe to touch)

5. Auxiliary interface: RS485
6. Auxiliary interface: Temperature, Irradiation, Energy meter (SO)
7. Auxiliary interface: Ethernet

Other

8. DC-switch

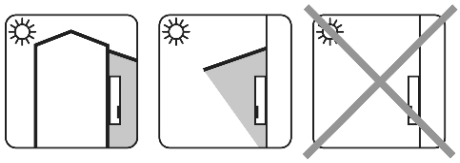
The inverter can also be configured via the Web Server. For further information refer to the Web Server User Manual.

3. Installation

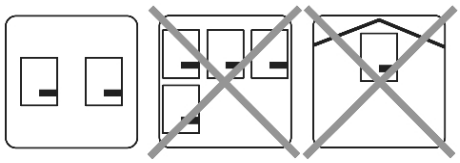
3.1. Installation Dimensions and Patterns

Note:
When choosing the installation place, ensure that all labels are visible at all times.
For details refer to the section *Specifications*.

Avoid constant stream of water.

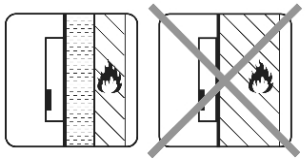


Avoid direct sunlight.

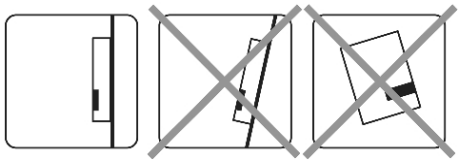


Ensure adequate air flow.

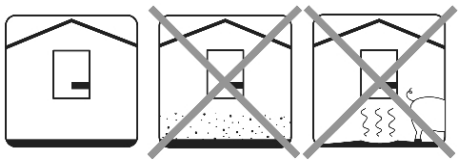
Ensure adequate air flow.



Mount on non-flammable surface.



Mount upright on vertical surface.



Prevent dust and ammonia gases.

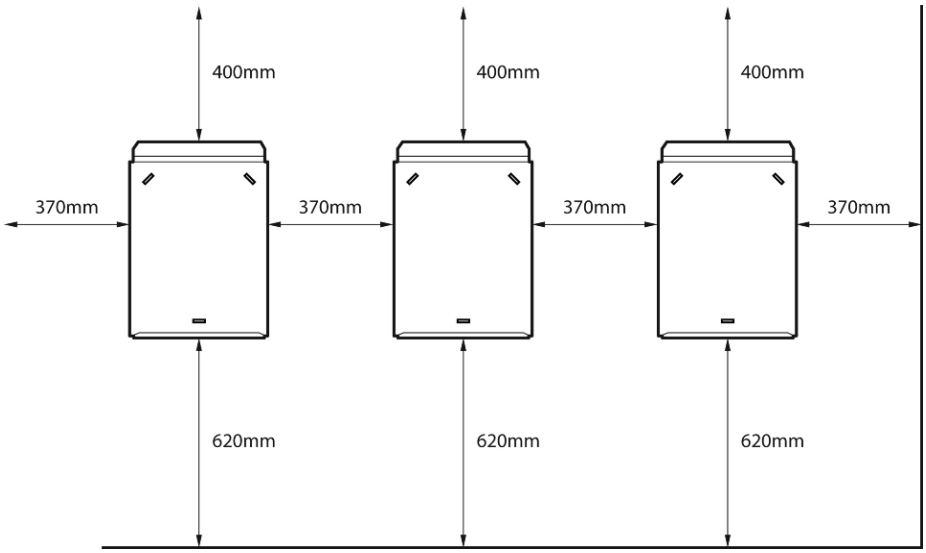


Illustration 3.1: Safe Distances

Observe these distances when installing one or more inverters. One row mounting is recommended. Contact the supplier for information on mounting in more rows.

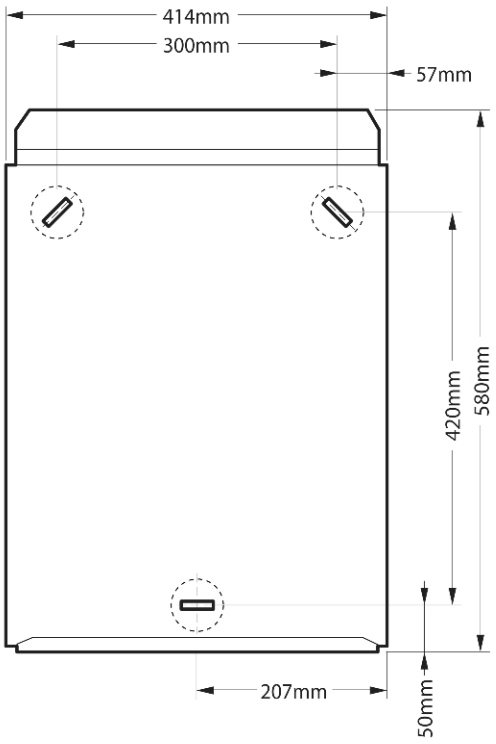


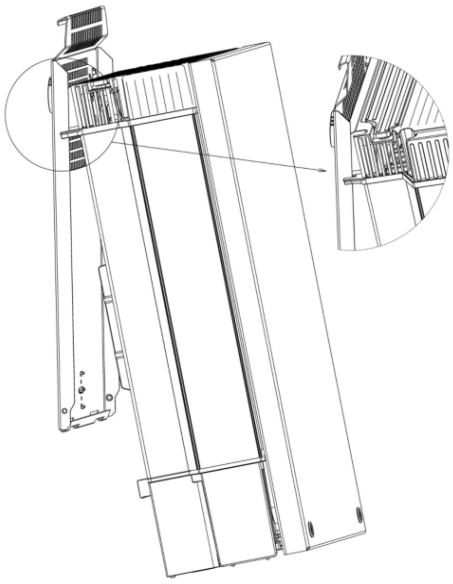
Illustration 3.2: Wall Plate

Note:
Use of the wall plate delivered with the inverter is mandatory.

Use screws that can safely carry the weight of the inverter. The inverter must be aligned and it is important that the inverter is accessible at the front to allow room for servicing.

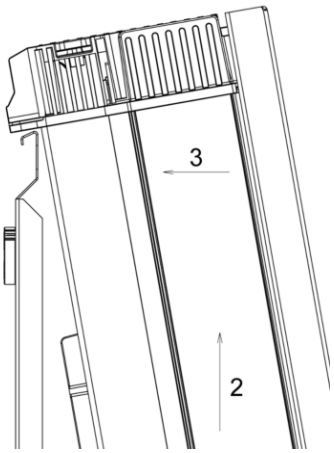
3.2. Mounting the Inverter

> For the safe handling of the inverter, two people must carry the unit, or a suitable transport trolley must be used. Safety boots must be worn.



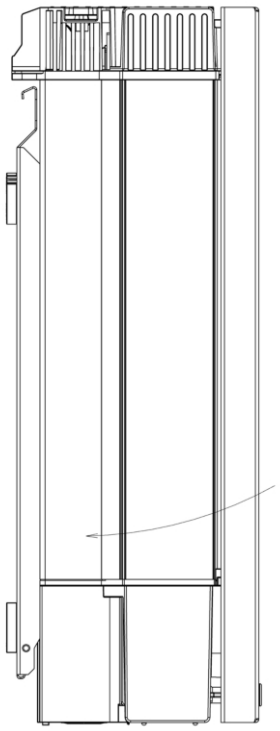
Tilt the inverter as shown in the illustration and place the top of the inverter against the mounting bracket. Use the two guides (1) at the top plate to control the inverter horizontally.

Illustration 3.3: Mounting the Inverter



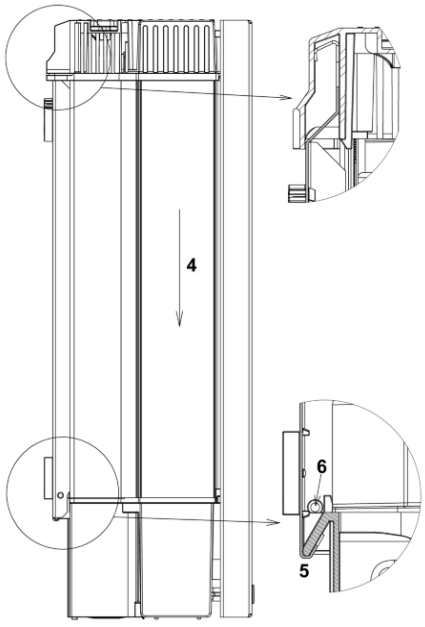
Lift the inverter upwards (2) over the top of the mounting plate until the inverter tilts towards the wall (3).

Illustration 3.4: Secure the inverter



Place the lower part of the inverter against the mounting bracket.

Illustration 3.5: Place Inverter in Mounting Bracket



Lower (4) the inverter and make sure that the hook of the inverter base plate is placed in the lower part of the mounting bracket (5). Check that it is not possible to lift the bottom of the inverter away from the mounting bracket.
(6) Fasten the screws on either side of the wall plate to secure the inverter.

Illustration 3.6: Fasten screws

3.3. Removing the Inverter

Loosen the locking screws on either side of the inverter.

Removal is performed in the reverse order of mounting. With a firm grip at the lower end of the inverter, lift the inverter approximately 20 mm vertically. Pull the inverter slightly away from the wall. Push upwards at an angle until the wall plate releases the inverter. Lift the inverter away from the wall plate.

3.4. Opening and Closing the Inverter

Remember to observe all ESD safety regulations. Any electrostatic charge must be discharged by touching the grounded housing before handling any electronic component.

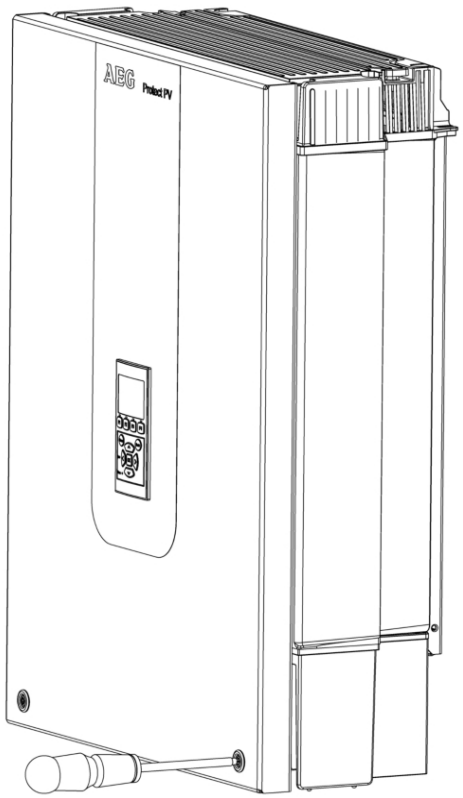
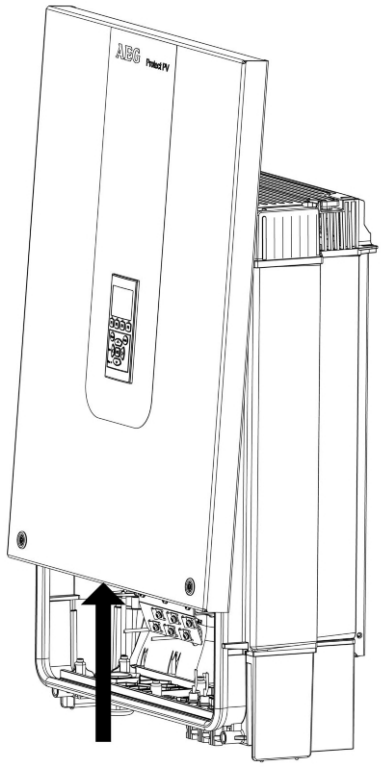


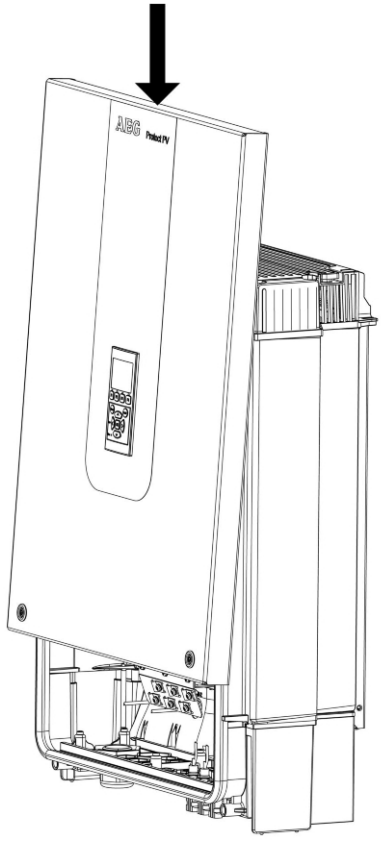
Illustration 3.7: Loosen Front Screws

Use a TX 30 screwdriver to loosen the two front screws. Turn the screwdriver until the screws pop up. They are secured with a spring and cannot fall out.



Push the front cover upwards. When a slight resistance is felt, give the front cover a tap on the bottom to snap it into holding position. It is recommended to use the holding position instead of dismounting the front cover completely.

Illustration 3.8: Open the Inverter



To close the inverter, hold on to the lower end of the front cover with one hand and give it a tap on the top until it falls into place. Guide the front cover into place and fasten the two front screws.

Illustration 3.9: Close the Inverter

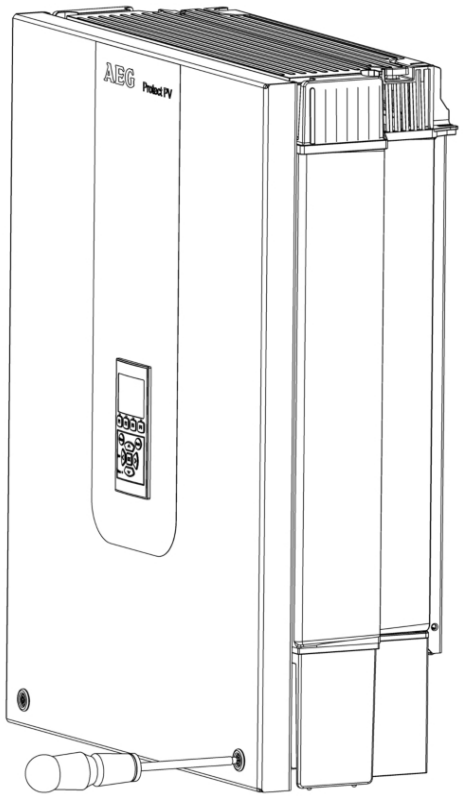


Illustration 3.10: Fasten Front Screws and Ensure Proper PE Connection.

The two front screws are the PE connection to the front cover. Make sure that both screws are mounted and fastened with the specified torque.

3.5. AC Grid Connection

Note: ✍
When choosing the installation place, ensure that all labels are visible at all times.
For details refer to the section *Specifications*.

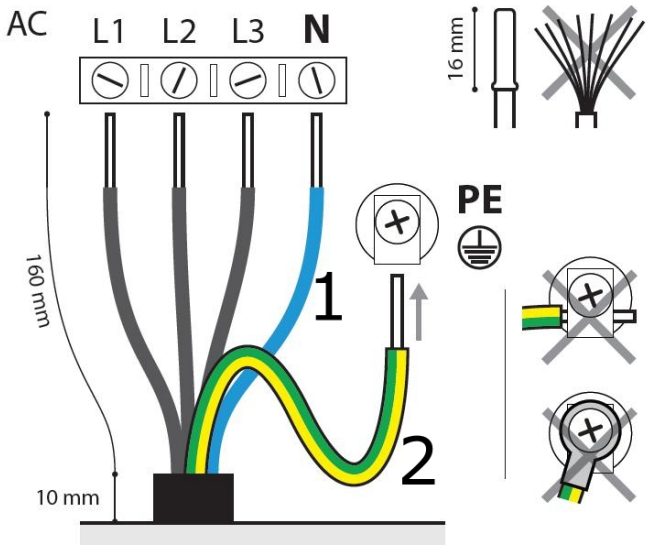


Illustration 3.11: AC Cable Wire Strip

Legend	
1	Blue cable - Neutral
2	Yellow/green cable - Earth

The illustration shows the stripping of insulation of all 5 wires of the AC cable. The length of the PE wire must be longer than the mains and neutral wires.

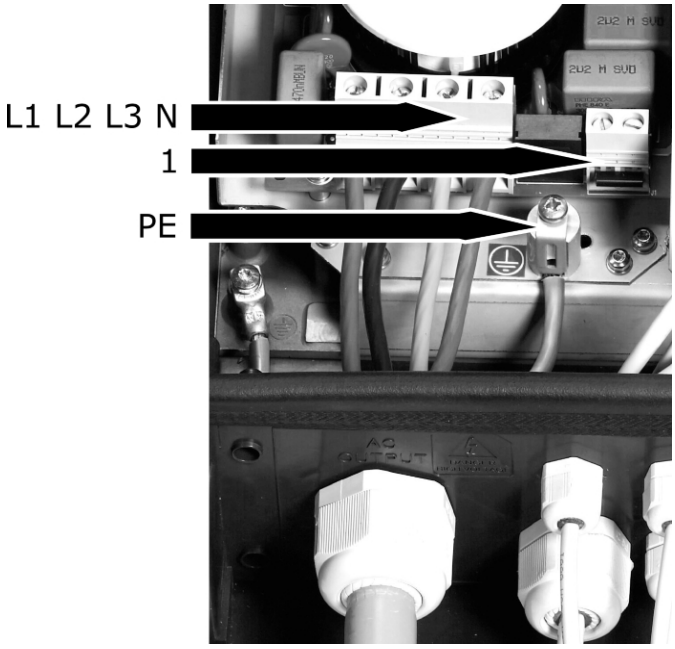


Illustration 3.12: AC Connection Area

1. Verify the inverter matches the grid-voltage
2. Release main circuit breaker and make precautions to prevent reconnection.
3. Open the front cover.
4. Insert the cable through the AC gland to the terminal blocks.
5. The three mains wires (L1, L2, L3) and the Neutral wire (N) are mandatory and must be connected to the 4-pole terminal block with the respective markings.

6. The Protective Earth wire (PE) is mandatory and must be connected directly to the chassis PE terminal. Insert the wire and fasten the screw to secure the wire.
7. All wires must be properly fastened with the correct torque. See the section *Technical Data, Torque Specifications for Installation*.
8. Close the front cover, and remember to verify that both front screws are applied with the correct torque to obtain PE connection.
9. Close main circuit breaker.

> **!** For safety, check all wiring. Connecting a phase wire to the neutral terminal may permanently damage the inverter. Do not remove the short circuit bridge at (1).

3.6. PV Connection

> **Note:** ✍
> When choosing the installation place, ensure that all labels are visible at all times.
> For details refer to the section *Specifications*.

> **!** Do NOT connect PV to earth!

Use a suitable voltmeter that can measure up to 1000 V DC.

1. First verify the polarity and maximum voltage of the PV arrays by measuring the PV open circuit voltage.The PV open circuit voltage must not exceed 1000 V DC.
2. Measure the DC voltage between the plus-terminal of the PV array and Earth (or the green/yellow PE cable). The voltage measured should approximate zero. If the voltage is constant and not zero there is an insulation failure somewhere in the PV array.
3. Locate and fix the failure before continuing.
4. Repeat this procedure for all arrays. It is allowed to distribute the input power on the inputs unevenly, presuming that:
   - The nom. PV power of the inverter is not exceeded (10.3 / 12.9 / 15.5 kW).
   - The individual input is not exceedingly loaded, and not more than 6000 W.
   - The maximum short circuit current of the PV modules at STC (Standard Test Conditions) must not exceed 12 A per input.

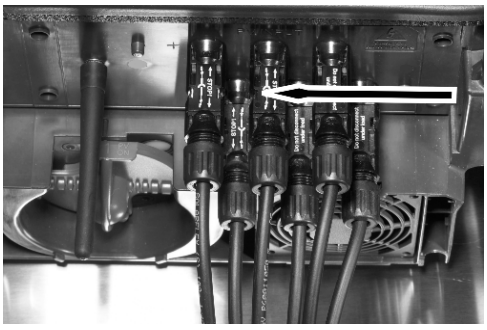


Illustration 3.13: DC Connection Area

On the inverter turn the PV load switch into off position. Connect the PV cables by means of MC4 connectors. Ensure correct polarity! The PV load switch can now be switched on when required.

When unmated the MC4 connectors are not IP54. The intrusion of moisture may occur in the following situations:

1. The inverter runs in Master/Slave operation and only one or two PV inputs are in use. In this case, the other inputs are not connected to PV and they are therefore open to intrusion.
2. Not all PV inputs are connected.
3. PV connectors are not fitted; for example in case of disconnection of parts of a PV plant over a longer period of time.

In situations where the PV connectors are not fitted, a seal cap must be mounted (included in the scope of the delivery). All inverters with MC4 connections are delivered with seal caps on inputs 2 and 3. During installation, the seal caps of those inputs that are to be used are discarded.

Note: ✍
The inverter is protected against reversed polarity but it will not generate power until the polarity is corrected. To achieve optimum production, the open circuit voltage (STC) of the PV modules must be lower than the max. input voltage of the inverter (see the specifications), multiplied with a factor of 1.13. U_{OC}, STC x 1.13 ≤ U_{MAX}, inv

3.7. Auxiliary Input/Output

Note: ✍
When choosing the installation place, ensure that all labels are visible at all times.
For details refer to the section *Specifications*.

The inverter has the following auxiliary input/output:

- 2 x RJ45 for RS485
- 2 x RJ45 for Ethernet
- 1 x 8 pole terminal block for RS485
- 1 x 10 pole terminal block for
  - PT1000 temperature sensor input x 3
  - Irradiation sensor input
  - Energy meter (S0) input
- 1 x 2 pole terminal block for relay outputs

Refer to the specifications for an overview of the communication board and to the inverter user manual for details regarding auxiliary input configuration via the display.

3.8. Autotest Procedure - Italy Only

An automatic test of the inverter can be initialised by activating the Inverter Autotest Software in the display. On the display find [Setup → Setup details → Autotest] and press OK. The autotest of the inverter will now start.
The inverter autotest manual can be obtained from the inverter manufacturer.

4. Start-up and Check of Settings

4.1. Start-up and Check of Settings

Note: ✍
Due to the advanced functionalities of the inverter, it may take up to 10 seconds before the display becomes available after power up.

Note: ✍
For the version the first start-up and check of settings can also be performed via the integrated Web Server. For further details, refer to the Web Server User Manual.

The inverter is shipped with a predefined set of settings for different countries. All country specific limits are stored in the inverter and must be selected at installation. It is always possible to see the applied country limits in the display. The inverter accounts for daylight saving automatically.
After installation, check all cables and then close the inverter.
Turn on AC at the mains switch.
When prompted by the display select language. This selection has no influence on the operating parameters of the inverter and is not a country selection.

The language is set to English at initial start-up. To change this setting press the OK button. Press ' ▼ ' to scroll down through the languages. Select language by pressing 'OK'.

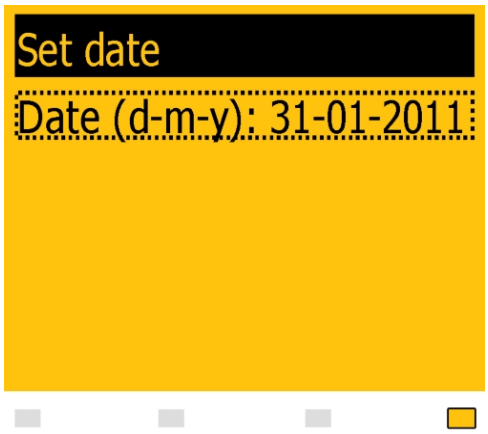
Illustration 4.1: Select Language

Note: ✍
To use the default language (English) simply press the 'OK' button twice to select and accept.

Set time as prompted by the display. Press 'OK' to select number. Press ' ▲ ' to scroll up through the numbers. Select by pressing 'OK'.
The clock is 24-hour format.

Illustration 4.2: Set Time

Note: ✍
It is very important to set the time and date accurately as the inverter uses this for logging. If a wrong time/date is accidentally set, correct it immediately in the set date and time menu [Setup → Inverter details → Set date and time].



Set date as prompted by the display. Press 'OK' to select. Press ' ▲ ' to scroll up through the numbers. Select by pressing 'OK'.

Illustration 4.3: Set Date

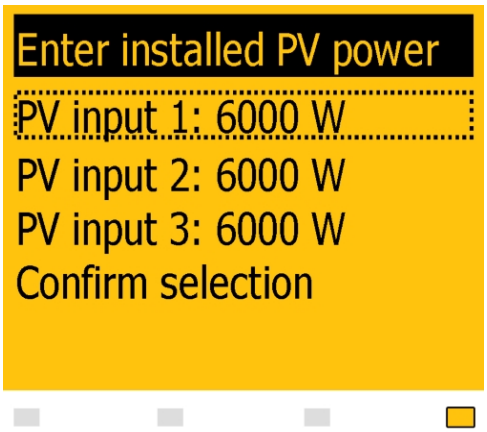


Illustration 4.4: Installed PV Power

Enter the amount of installed PV power for each of the PV inputs. When two or more PV inputs are connected in parallel, each PV input in the parallel group must be set to the total amount of PV power installed to that group divided by the number of parallel inputs. See the table below for examples of installed PV power.

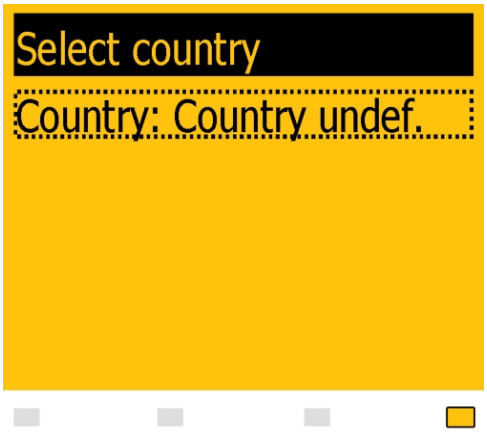


Illustration 4.5: Select Country

The display will now show "Select country". The country is set to "undefined" at initial start-up. To select country press 'OK'. Press ' ▼ ' to scroll down through the list of countries. Select the country in which the inverter is installed by pressing 'OK'. To meet medium voltage grid requirements select a country option ending in MV. It is very important that the correct country is chosen.

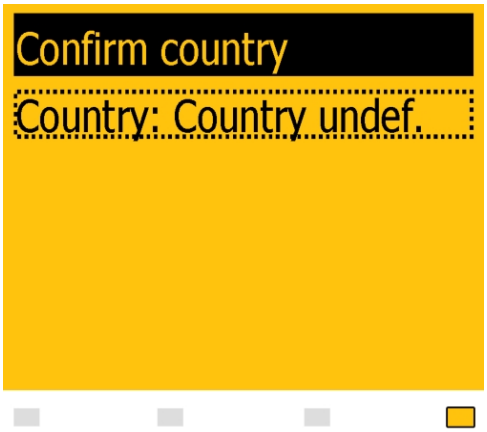


Illustration 4.6: Confirm Country Selection

Confirm the choice by selecting the country again and press 'OK'. The settings for the chosen country have now been activated.

The inverter only complies with local and national standards provided the correct country has been selected. If a different country than the one the inverter is installed in is chosen it can have serious consequences.

Note: ✍
If the two country selections do not match they will be cancelled and it will be necessary to redo the selections. If a wrong country is accidentally accepted at the first selection, simply accept the "Country: Undefined" in the confirm country screen. This will cancel the country selection and a new selection is possible. If a wrong country is selected twice, call service.

The inverter will start automatically if sufficient solar radiation is available. The start-up will take a few minutes. During this period, the inverter will carry out a self-test.

Actual Configuration	***"Installed PV power"*** to be programmed
PV1, PV2 and PV3 are all set into individual mode. The nominal PV power installed are: PV 1: 6000 W PV 2: 6000 W PV 3: 3000 W	 PV 1: 6000 W PV 2: 6000 W PV 3: 3000 W
PV1 and PV2 are set into parallel mode and have a total of 10 kW PV power installed. PV3 is set into individual mode and has nominal 4 kW PV power.	PV 1: 5000 W PV 2: 5000 W PV 3: 4000 W
PV1 and PV2 are set into parallel mode and have a total of 11 kW PV power installed. PV3 is set to 'Off' and has no PV installed.	PV 1: 5500 W PV 2: 5500 W PV 3: 0 W

Table 4.1: Examples of Installed PV Power

Note: ✍
To meet medium voltage grid requirements, select a country option ending in (MV).

4.2. Troubleshooting

For information on Troubleshooting, please see the Protect PV Reference Manual.

4.3. Master Mode

The inverters include a Master Mode feature that allows one inverter to be appointed as Master Inverter. From the Master Inverter's web interface it is possible to access any inverter in the network from one single point using a standard web browser. The Master Inverter can act as a datalogger, collecting data from all inverters in the network. These data can be displayed graphically from the Master Inverter's own web server or can also be uploaded to external web-portals or exported directly to a PC. The Master Inverter is also able to replicate settings and data to the other inverters in the network, enabling easy commissioning and data management

of larger networks. Replication can be performed once, prior to defining the country setting in follower inverters.

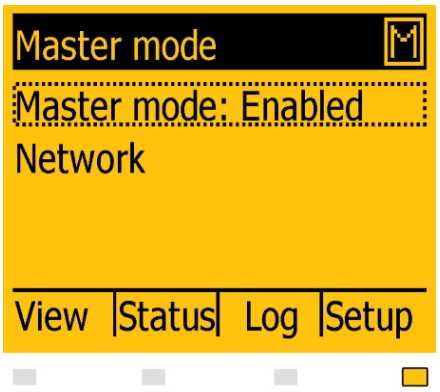


Illustration 4.7: Master Mode

To enable Master mode go to the *Inverter details* menu [Setup → Inverter details → Master mode] and set Master mode to *Enabled.* Ensure that no other master inverters are present in the network prior to carrying out this action.
When Master mode is enabled, it is possible to initiate a network scan [Setup → Inverter details → Master mode → Network]. This will show all inverters connected to the master inverter.

5. Technical Data

5.1. Technical Data

Nomen-cla-ture [1]	**Parameter**	Protect PV 10 kW	Protect PV 12.5 kW	Protect PV 15 kW
	AC			
$P_{ac,r}$	Max./Nom. power AC	10000 W	12500 W	15000 W
	Reactive power range	0-6.0 kVA_r	0-7.5 kVA_r	0-9.0 kVA_r
$V_{ac,r}$	AC voltage range (P-N)	3x230 V ± 20 %	3x230 V ± 20 %	3x230 V ± 20 %
	Nominal current AC	3 x 15 A	3 x 19 A	3 x 22 A
I_{acmax}	Max. current AC	3 x 15 A	3 x 19 A	3 x 22 A
	AC current distortion (THD %)	< 5 %	< 5 %	< 5 %
$cosphi_{ac,r}$	Power factor at 100 % load	0.99	0.99	0.99
	Controlled power factor range	0.8 over-excited 0.8 under-excited	0.8 over-excited 0.8 under-excited	0.8 over-excited 0.8 under-excited
	"Connecting" power loss	10 W	10 W	10 W
	Night-time power loss (off grid)	< 5 W	< 5 W	< 5 W
f_r	Grid frequency	50 ± 5 Hz	50 ± 5 Hz	50 ± 5 Hz
	DC			
	Nominal power DC	10300 W	12900 W	15500 W
	Max. recommended PV power at STC [2]	11800 Wp	14700 Wp	17700 Wp
$V_{dc,r}$	Nominal voltage DC	700 V	700 V	700 V
V_{mppmin} - V_{mppmax}	MPP voltage - nominal power [3]	430-800 V	358-800 V	430-800 V
	MPP efficiency	99.9 %	99.9 %	99.9 %
V_{dcmax}	Max. DC voltage	1000 V	1000 V	1000 V
$V_{dcstart}$	Turn on voltage DC	250 V	250 V	250 V
V_{dcmin}	Turn off voltage DC	250 V	250 V	250 V
I_{dcmax}	Max. current DC	2x12 A	3x12 A	3x12 A
	Max. short circuit current DC at STC	2x12 A	3x12 A	3x12 A
	Min. on grid power	20 W	20 W	20 W
	Efficiency			
	Max. efficiency	98 %	98 %	98 %
	Euro efficiency, V at $_{dc,r}$	97.0 %	97.3 %	97.4 %
	Other			
	Dimensions (L,W,H)	700x525x250 mm	700x525x250 mm	700x525x250 mm
	Mounting recommendation	Wall bracket	Wall bracket	Wall bracket
	Weight	35 kg	35 kg	35 kg
	Acoustic noise level[4]	56 dB(A)	56 dB(A)	56 dB(A)
	MPP trackers	2	3	3
	Operation temperature range	-25..60 °C	-25..60 °C	-25..60 °C
	Nom. temperature range	-25..45 °C	-25..45 °C	-25..45 °C
	Storage temperature	-25..60 °C	-25..60 °C	-25..60 °C
	Overload operation	Change of operating point	Change of operating point	Change of operating point
	Overvoltage category AC	Class III	Class III	Class III
	Overvoltage category DC	Class II	Class II	Class II
	PLA	Included	Included	Included
	Reactive power	Protect PV and Protect PV easy	Protect PV and Protect PV easy	Protect PV and Protect PV easy
	Functional Safety			
	Islanding detection - loss of mains	Three-phase monitoring (ROCOF)	Three-phase monitoring (ROCOF)	Three-phase monitoring (ROCOF)
	Voltage magnitude	Included	Included	Included
	Frequency	Included	Included	Included
	DC content of AC current	Included	Included	Included
	Insulation resistance	Included	Included	Included
	RCMU - Type B	Included	Included	Included
	Indirect contact protection	Yes (class I, grounded)	Yes (class I, grounded)	Yes (class I, grounded)
	Short circuit protection	Yes	Yes	Yes

Table 5.1: Specifications

1) According to FprEN 50524.
2) For fixed systems with semi-optimal conditions.
3) At identical input voltages. At unequal input voltages, V_{mppmin} can be as low as 250 V depending on total input power.
4) SPL (Sound Pressure Level) at 1.5m.

Normative References	Protect PV 10 kW	Protect PV 12.5 kW	Protect PV 15 kW
Directive LVD	2006 / 95/ EC		
Directive EMC	2004 / 108 / EC		
Safety	EN 50178	EN 50178	EN 50178
Integrated PV load switch	VDE 0100-712		
EMC immunity	EN 61000-6-1		
	EN 61000-6-2		
EMC emission	EN 61000-6-3		
	EN 61000-6-4		
Utility interference	EN 61000-3-2 / -3	EN 61000-3-11 / -12	EN 61000-3-11 / -12
CE	Yes		
Utility characteristics	IEC 61727		
	EN 50160		
S0 Energy Meter	EN62053-31 Annex D		
Functional Safety	For transformerless inverter		
Germany	DIN VDE 0126-1-1*		
Greece	Technical requirements for the connection of independent generation to the grid, Public Power Corporation (PPC).		
Italy	DK5940-2.2 (2007)		
Spain	RD1663 (2000)		
	RD661		
Reactive Power	Protect PV and Protect PV easy		
	Protect PV 10 kW	Protect PV 12.5 kW	Protect PV 15 kW
Austria	TOR – Hauptabschnitt D4, TOR – Hauptabschnitt D2		
Belgium	Synergrid C10/11 – revisie 12 mei 2009, Synergrid C10/17- revisie 8 mei 2009		
Czech Republic	Czech Energy Act (Act No. 458/2000), Article 24, Paragraph 10 part I,II,III rev09 2009		
France	UTE NF C 15-712-1 (UNION TECHNIQUE DE L'ELECTRICITE, GUIDE PRATIQUE, Installations photovoltaïques raccordées au réseau public de distribution). NF C 15-100 (Installations électriques à basse tension). Journal Officiel, Décret n°2008-386 du 23 avril 2008 relatif aux prescriptions techniques générales de conception et de fonctionnement pour le raccordement d'installations de production aux réseaux publics d'électricité.		
Germany	BDEW - Technische Richtlinie Erzeugungsanlagen am Mittelspannungsnetz Ausgabe, Juni 2008		
Spain	REE BOE núm. 254		

Table 5.2: Norms and Standards

* Deviant from VDE 0126-1-1 section 4.7.1, the isolation resistance measurement limit is set to 200 kΩ, in accordance with authorities.

Parameter	Specification
Temperature	-25°C - +60°C (>45°C derating)
Environmental class according to IEC	IEC60721-3-3 3K6/3B3/3S3/3M2
Air quality	ISA S71.04-1985 Level G2 (at 75%RH)
Coastal, heavy industrial and farmer areas	Must be measured and classified acc. to ISA S71.04-1985
Vibration	1G
Ingress protection class	54
Max. operating altitude	3000m above sea level. PELV protection is effective up to 2000m above sea level only.
Installation	Avoid constant stream of water. Avoid direct sunlight. Ensure adequate air flow. Mount on non-flammable surface. Mount upright on vertical surface. Prevent dust and ammonia gases.

Table 5.3: Conditions for Installation

Parameter	Condition	Specification
Wall Plate	Hole diameter	30 x 9 mm
	Alignment	Perpendicular ± 5° all angles

Table 5.4: Wall Plate Specifications

5.1.1. Cable Requirements

Cable	Condition	Specification
AC	**5 wire cable**	**Copper**
Outer diameter		18-25 mm
Insulation strip	All 5 wires	16 mm
Max. recommended cable length Protect PV 10	2.5 mm^2	21 m
	4 mm^2	34 m
	6 mm^2	52 m
	10 mm^2	87 m
Max. recommended cable length Protect PV 12.5	4 mm^2	28 m
	6 mm^2	41 m
	10 mm^2	69 m
Max. recommended cable length Protect PV 15	6 mm^2	34 m
	10 mm^2	59 m
PE Cable diameter	at least	as phase cables
DC		**Max. 1000 V, 12 A**
Cable length	4 mm^2 - 4.8 Ω /km	< 200 m*
Cable length	6 mm^2 - 3.4 Ω /km	>200-300 m*
Mating connector	Multi-contact	PV-ADSP4./PV-ADBP4.
* The distance between inverter and PV array and back, plus the summarised length of the cables used for PV array installation.		

Table 5.5: Cable Requirements

Note: ✍
Avoid power loss in cables of more than 1 % of nominal inverter rating.

Note: ✍
In France, observe the UTE C 15-712-1 and NF C 15-100 requirements.

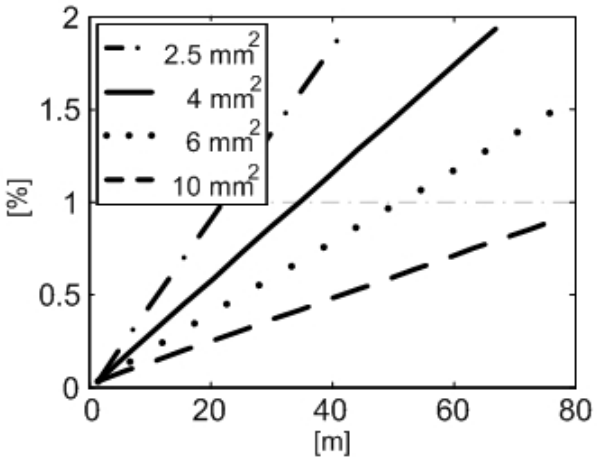


Illustration 5.1: Protect PV 10 kW Cable Losses [%] versus Cable Length [m]

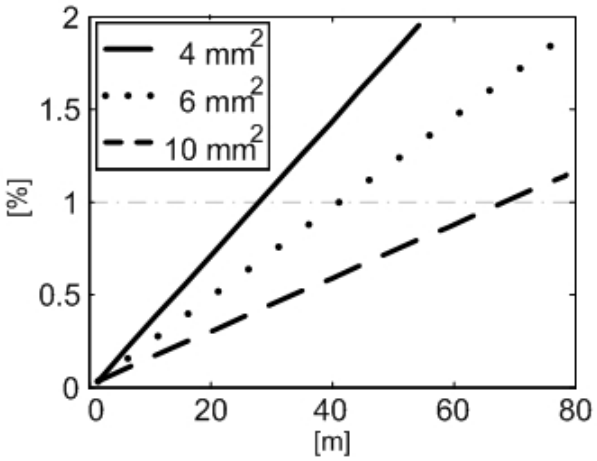


Illustration 5.2: Protect PV 12.5 kW Cable Losses [%] versus Cable Length [m]

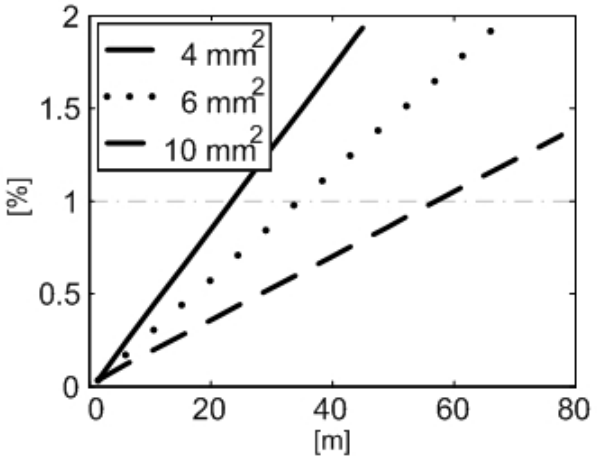


Illustration 5.3: Protect PV 15 kW Cable Losses [%] versus Cable Length [m]

Consider also the following when choosing cable type and cross-sectional area:

- Ambient temperature

- Layout type (inside wall, under ground, free air etc.)
- UV resistance

Illustration 5.4: Overview of Inverter with Torque Indications

	Parameter	Screwdriver	Tightening Torque
1	Front screws	TX 30	6-8 Nm
2	Locking screw	TX 30	5 Nm
3	Terminal blocks (small)	Straight slot 0.5x3.0 mm	0.5 Nm
4	Terminal blocks (large)	Straight slot 1.0x5.5 mm	Min. 1.2 Nm
5	PE	Straight slot 1.0x5.5 mm	2.2 Nm
6	M16	SW 19 mm	2-3 Nm
7	M25	SW 30 mm	2-3 Nm

Table 5.6: Nm Specifications

	Protect PV 10 kW	Protect PV 12.5 kW	Protect PV 15 kW
Maximum inverter current	15 A	19 A	22 A
Recommended fuse type gL/gG	16 A	20 A	25 A

Table 5.7: Mains Circuit Specifications

5.1.2. Wiring Diagram

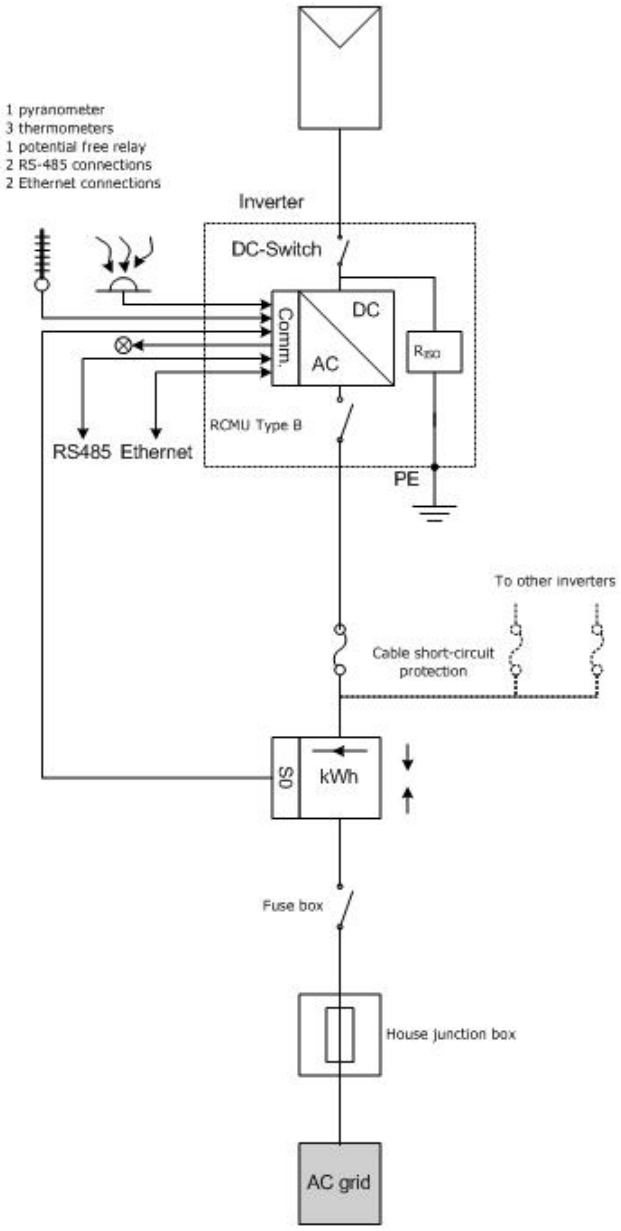


Illustration 5.5: Typical Installation

5.1.3. Auxiliary Interface Specifications

Parameter	Parameter details	Specification
Serial Communication		**RS485**
Common cable specification	Cable jacket diameter (⌀)	2 x 5-7 mm
	Cable type	Shielded Twisted Pair (STP) (Cat 5e)[2)]
	Cable Characteristic Impedance	100 Ω – 120 Ω
	Max. cable length	1000 m
RJ45 (2 pcs.) connectors	Wire gauge	24-26 AWG (depending on mating metallic RJ45 plug)
	Cable shield termination	Via metallic RJ45 plug
Terminal block	Maximum wire gauge	2.5 mm^2
	Cable shield termination	Via EMC cable clamp
Max. number of inverter nodes		63[4)]
Galvanic interface insulation		Yes, 500 Vrms
Direct contact protection	Double/Reinforced insulation	Yes
Short circuit protection		Yes
Communication	Star and daisy chain	**Ethernet**
Common cable	Max. cable length between inverters	100 m (total network length: unlimited)
Specification	Max. number of inverters	100[1)]
	Cable type	Shielded Twisted Pair (STP) (Cat 5e)[2)]
Temperature sensor input		**3 x PT1000** [3)]
Cable specification	Cable jacket diameter (⌀)	4-8 mm
	Cable type	Shielded Single Pair - 2-wire
	Cable shield termination	Via EMC cable clamp
	Maximum wire gauge	2.5 mm^2
	Maximum resistance per wire	10 Ω
	Maximum cable length	30 m
Sensor specification	Nominal resistance/temperature coefficient	3.85 Ω/ºC
	Measurement range	-20 ºC - +100 ºC
	Measurement accuracy	±3%
Direct contact protection	Double/Reinforced insulation	Yes
Short circuit protection		Yes
Irradiation sensor input		**x 1**
Cable specification	Cable jacket diameter (⌀)	4-8 mm
	Cable type	Shielded Single Pair - Number of wires depend on the sensor type used
	Cable shield termination	Via EMC cable clamp
	Maximum wire gauge	2.5 mm^2
	Maximum resistance per wire	10 Ω
	Maximum cable length	30 m
Sensor Specification	Sensor type	Passive
	Measurement accuracy	±5% (150 mV sensor output voltage)
	Output voltage of sensor	0-150 mV
	Max. output impedance (sensor)	500 Ω
	Input impedance (electronics)	22 kΩ
Direct contact protection	Double/Reinforced insulation	Yes
Short circuit protection		Yes
Energy meter input	**S0 input**	**x 1**
Cable specification	Cable jacket diameter (⌀)	4-8 mm
	Cable type	Shielded Single Pair - 2-wire
	Cable shield termination	Via EMC cable clamp
	Maximum wire gauge	2.5 mm^2
	Maximum cable length	30 m
Sensor Input Specification	Sensor input class	Class A
	Nominal output current	12 mA for an 800 Ω load
	Maximum short circuit output current	24.5 mA
	Open circuit output voltage	+12 VDC
	Maximum pulse frequency	16.7 Hz
Direct contact protection	Double/Reinforced insulation	Yes
Short circuit protection		Yes

Table 5.8: Auxiliary Interface Specifications

1) Max. number of inverters are 100. If GSM modem is used for portal upload, the amount of inverters in a network is limited to 50.
2) For outdoor use, we recommend outdoor burial type cable (if buried in the ground) for both Ethernet and RS485.
3) Third input is used for compensation of the irradiation sensor.
4) The number of inverters to be connected in the RS485 network depend on which peripheral device is connected.

> To ensure fulfilment of IP enclosure rating, correctly mounted cable glands are essential for all peripheral cables.

> To ensure EMC compliance, shielded cables must be applied for Sensor inputs and RS485 communication. Unshielded cables may be applied for alarm outputs.
> Other auxiliary cables must pass through the designated EMC cable clamps to establish mechanical fixing and in case of shielded cable termination to the shielding device.

Parameter	Condition	Specification
Potential free contact	**Relay output**	**x 1**
Rating AC		250 VAC, 6.4 A, 1600 W
Rating DC		24 VDC, 6.4 A, 153 W
Maximum wire gauge		2.5 mm^2
Over voltage category		Class III
Optional		
Modem		GSM

Table 5.9: Auxiliary Input Specifications

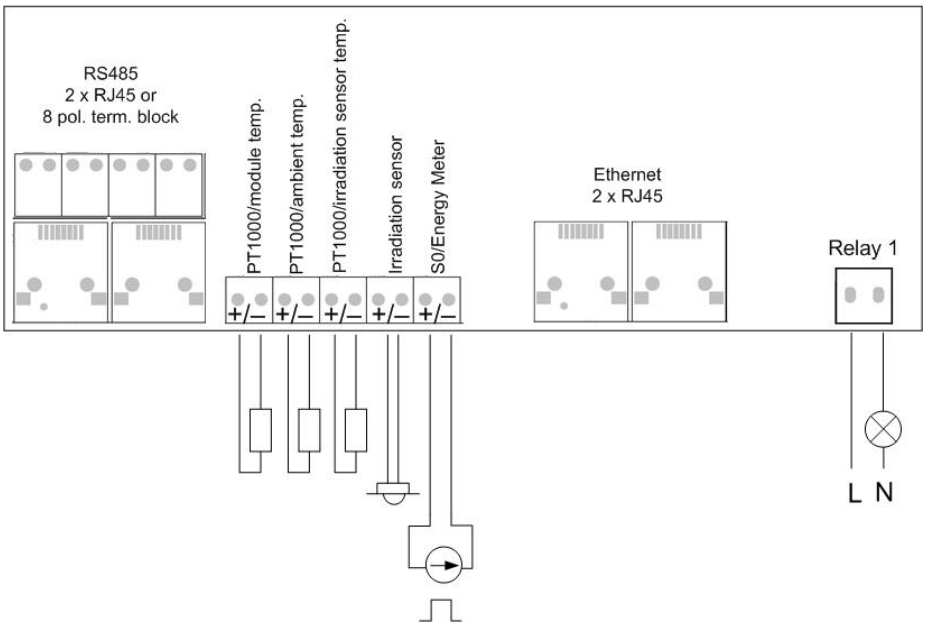


Illustration 5.6: Communication Board

5.1.4. RS485 Communication Board Connections

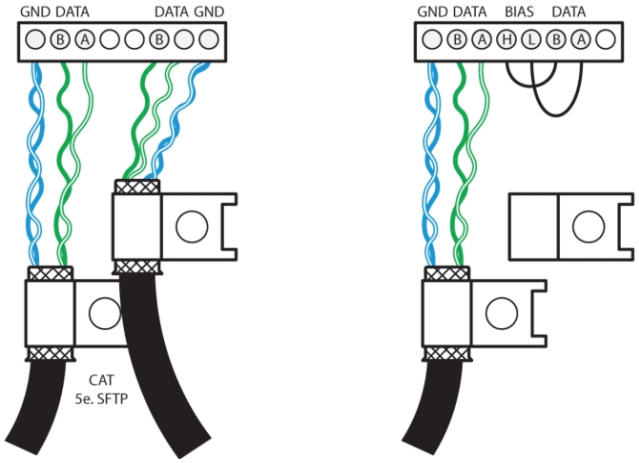
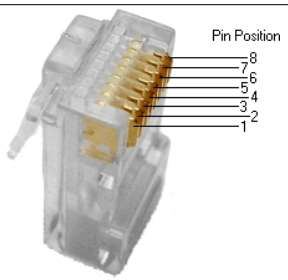


Illustration 5.7: RS485 Detail of Communication Board.

BIAS L and Bias H are to be connected to RX/TX B and RX/TX A respectively for termination of RS485 bus.



Pinout RS-485	Pinout Ethernet only, via the RJ45 connector
1. **GND**	1. RX+
2. GND	2. RX
3. **RX/TX A (-)**	3. TX+
4. BIAS L	4.
5. BIAS H	5.
6. **RX/TX B (+)**	6. TX-
7. Not connected	7.
8. Not connected	8.
Bold = Compulsory, Cat5 cable contains all 8 wires For Ethernet: 10Base-TX and 100Base-TX auto cross over	

Table 5.10: RJ45 Pinout Detail

Note:
The RS485 communication bus must be terminated at both cable ends.

Note:
The two network types cannot be mixed. The inverters can only be connected in networks which are either solely RS485 or solely Ethernet.

Note:
Each inverter has a unique RS485 address when it is delivered. This address is defined at the time of production.

Note:
Ethernet connection is recommended for faster communication.
RS485 connection is required when a web logger or data logger is connected to the inverter.

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